Amendments to the Specification

Please amend the specification as follows:

[0001] The invention relates to methods and devices for the contactless detection of flat objects ~~according to the preamble of claims 1 and 6 and devices according to the preambles of claims 37 and 41~~.

[0006] With a view to a better control of the aforementioned problems, specifically in the case of widely differing material-specific attenuation of the transmitted signal and in connection with which hereinafter reference will be made solely to weights per unit area and gram weights, a ~~teach-in~~ learning step was performed. Before the start of the actual detection process the flat object to be detected, such as e.g. a paper sheet, is detected in connection with its gram weight or its sound absorption characteristics and inputted into the evaluating device in the sense of a ~~teach-in~~ learning step.

[0007] A significant disadvantage is that in the case of other flat objects with a different gram weight it is once again necessary to perform a corresponding ~~teach-in~~ learning step, which is on the one hand complicated and on the other normally leads to considerable disuse periods for the corresponding plants.

[0014] DE 297 22 715 U1 discloses an inductively operating device for measuring the thickness of plates, which can be made from ferrous or nonferrous metals. The measurement of the plate thickness takes place through the evaluation of the operating frequency of a frequency generator or through evaluating its amplitude. For setting this device it is firstly necessary to perform a ~~teach-in~~ learning step, in which a calibration plate is introduced into the measurement zone and the operating frequency or amplitude of the frequency generator is set in accordance with a standard thickness curve.

[0020] DE 40 22 325 C2 discloses another acoustically or ultrasonically based method. This method, which is based on controlling missing or multiple sheets in the case of sheet or foil-like objects, requires a first pass of the corresponding flat object with a calibration and setting process, which is automatically performed in microprocessor-controlled manner. Thus, with this method a ~~teach-in~~ learning step is initially required concerning the thickness of the object relative to an optimum measuring and frequency range and during such a first pass a corresponding threshold value must be detected and stored.

[0022] DE 199 21 217 A1 (7), together with DE 199 27 865 A1 and EP 1 067 053 B1 discloses a device for detecting labels or flat objects. This device uses ultrasonic waves with a modulation frequency and for distinguishing single and multiple sheets a threshold value is determined during a balancing process or a ~~teach-in~~ learning step. By means of the ~~teach-in~~ learning step it is possible to adjust the detection to a specific flat object in the sense of a label. However, this ~~teach-in~~ learning step makes the device more complex and requires longer setting times when changing to a different flat object. This shows that a broader material spectrum cannot be detected per se, but only matched to a specific, individual material.

[0023] Bearing in mind this prior art, the object of the invention is to design a method and a device for the contactless detection of flat objects, permitting in a very flexible manner over a wide material spectrum a reliable detection of single, missing or multiple sheets with different flat materials on the one hand, particularly papers, foils, films, plates, etc., and on the other in the case of labels and similar laminated materials, without requiring a ~~teach-in~~ learning step and using different beams or waves such as those of an optical, acoustic, inductive or similar nature.

~~[0024] According to the invention this problem is solved from the method standpoint by the features of claims 1 or 6 and from the device standpoint by the features of claims 37 or 41.~~

[0034] According to the invention these measures lead to the advantage that a reliable detection is obtained of the corresponding flat objects over a very wide gram weight and weight per unit area range without the need for a ~~teach-in~~ learning process, which would lead to plant disuse times. In addition, the dynamic range of the evaluating device is significantly extended, so that it is reliably possible to detect very thin or very inhomogeneous materials having a fluttering tendency. Therefore the method according to the invention makes it possible on the basis of the amplitude evaluation of the measuring signal received in the receiver and by using a correction characteristic and target characteristic to make a reliable distinction between single, missing and multiple/double sheets and this applies also for very thin or very sound-transmissive objects, e.g. with a weight per unit area from 8 g/m2 or a thickness of approximately 10 µm to relatively thick and highly sound-transmissive objects up to 4000 g/m2 and e.g. a thickness of 4 mm, without any prior ~~teach-in~~ learning process being required to enable a reliable distinction to be made.

[0038] Thus, according to the invention, both in a method and by means of a device it is possible to detect labels, splice, tear-off or break points and similarly built up materials without a ~~teach-in~~ learning step. It must be borne in mind that the weight per unit area range for labels and similar materials can be from approximately 40 to approximately 300 g/m2, i.e. is relatively narrow.

[0045] Thus, for label detection the aim is to permit a maximum constant signal swing over the entire material range in the case of the aforementioned design of the correction characteristic as a result of the target characteristic, i.e. [[dUZ]] ΔUZ should be at a maximum/constant.

[0046] As opposed to this, the correction characteristic method for detecting single, missing and multiple sheets is based on a design of the target characteristic in which, over the entire gram weight range, for single sheet detection purposes there is a minimum change to the amplitude values, i.e. [[dUZ]] ΔUZ=0 and ideally there is a constant magnitude or target characteristic with a gradient of approximately 0.

[0047] For practical purposes importance is attached to the combination of a logarithmic and a linear correction characteristic. The advantage of a signal amplifier with impressed logarithmic correction characteristic or a similar correction characteristic is more particularly that the signal amplifier has a very large dynamic range, so that a large ratio of voltage signals from the largest to the smallest signal can undergo processing. A linear signal amplifier can e.g. obtain a voltage-signal ratio of approximately 50:1, which corresponds to approximately 34 dB. However, a logarithmic signal amplifier achieves a voltage-signal ratio of ~~3x104:1~~ 3x10^4:1, which is approximately 90 dB. When using a logarithmic signal amplifier, which is here understood to mean an impressed logarithmic correction characteristic, it is possible to counteract a signal overload at high signal amplitudes. This feature is advantageously used according to the invention in order to implement single, missing or multiple sheet detection and for the detection of stackable packs, without carrying out a ~~teach-in~~ learning process and over a very wide material spectrum.

[0063] A particular advantage of the ultrasonic method is that the spacing between transmitter and receiver in the sensor device can be made variable for this ~~teach-in~~ learning-free method. In other words the sensor device can be relatively rapidly adapted spacingwise to different applications, without this impairing the measurement precision of the method. A further improvement to the method can be brought about by monitoring the spacing between the transmitter and receiver and the determination thereof. This determination of the spacing between transmitter and receiver can on the one hand take place by reflection of radiation between transmitter and receiver and on the other by reflection between transmitter and receiver in spite of flat material present in the gap and even when it is a thick sheet. If the permitted maximum sensor spacing is exceeded and detected, the evaluating device, e.g. a microprocessor, can effect a corresponding correction of the determined amplitude values of the measuring signal as a function of the spacing between transmitter and receiver.

[0067] As from the method and device standpoint label detection appropriately takes place by means of a second channel, this does not affect a ~~teach-in~~ learning-free detection for single or multiple sheets implemented with a first channel of the evaluating device.

[0111] Fig. 2 and the associated fig. 2a, 2b, 2c, 2d diagrammatically illustrate the method and a device for detecting labels and similar materials without the need for the performance of a ~~teach-in~~ learning step. The reference numerals correspond to those of fig. 1.

[0127] This example illustrates the fact that, according to the invention, it is readily possible to bring about the detection as a "missing sheet" or "air" or as a "multiple or double sheet" over a wide gram weight or weight per unit area range without using a ~~teach-in~~ learning process.

[0176] In connection with the combination of correction characteristics this can also be implemented in a signal amplifier or in several series or parallel-connected, individual signal amplifiers in order to produce an overall gain. Thus, correction characteristic implementation can take place in the most varied ways, because the essential idea of the invention is to detect single, missing or multiple sheets over a wide gram size range without having to integrate a ~~teach-in~~ learning process.

[0181] Fig. 9 diagrammatically shows an inventive device 40 for the contactless detection of multiple sheets A, without performing a ~~teach-in~~ learning step, and the detection of material layers B, e.g. labels adhesively applied to a base material.